Physics 567
Homework Assignment 1
Due Friday, January 22, 2016

Until a few decades ago, the best available mirror coatings for extreme ultraviolet (EUV) light were elements with high atomic number Z, such as gold. Typical reflectivities were just a few percent. Then in 1976, Eberhard Spiller demonstrated that mirror coatings made of many layers, alternating two materials with different Z, can reflect extreme ultraviolet light with high efficiency (tens of percent) over a narrow passband.[1] EUV multilayer coatings have since been used in numerous scientific satellite missions, including *ALEXIS*, *SOHO*, *TRACE*, *Planet-B*, *IMAGE*, and *SDO*.

The objective of this assignment is to write a function that uses the cubic spline to interpolate reflectivity data for a multilayer mirror. *In this and all future homework assignments, I encourage you to make use of existing code including my examples and the built-in functions in Octave and Matlab.* You will find examples of such data in the web directory with this assignment. They have filenames like `xray1234.dat.txt`, and were generated using an online tool provided by the Center for X-ray Optics (CXRO): `http://henke.lbl.gov/optical_constants/multi2.html`. Each file contains three columns of numbers. The third column, giving the phase of the reflected light, will not be needed for this assignment.

Your function should start out like this:

```
function reflectivity = solution(filename, lambda)
```

Your code should work with any unmodified data file from CXRO. For example, the function might be used this way:

```
octave:1> wav = 100:0.01:300
octave:2> ref = solution('xray8529.dat.txt', wav)
```

Physically reasonable values of reflectivity are between 0 and 1. It occasionally happens that a cubic spline of data that are in this range but rapidly fluctuating will produce some out-of-range values. Your code should force all output reflectivities to be within the appropriate range. Your code should also produce a good plot of the results as described below.

Please turn in the following items to the grader via email:

1. All source code. If you use functions that are not standard with Octave or MATLAB, include them. All code you write should be indented and clearly commented for readability.

[1] Applied Optics, Vol. 15, Issue 10, pp. 2333-2338 (1976)

2. A smooth plot of the data from `xray8529.dat.txt`, interpolated by your function to very fine resolution, with plus signs marking the original data. Label the axes and provide a legend.

3. An example from the command line of how you executed your code and plotted the results (like my little two-line example above).

4. Specify whether you used Octave or MATLAB, so our grader can easily run the code.

HINTS: The `find` function may be used to locate out-of-range values. Reading in the CXRO datafiles with Octave or MATLAB can be tricky. When the function `dlmread` is called with no arguments other than the filename, it is smart enough to figure out what the delimiter is and will treat extra whitespace as part of the same delimiter. Since you cannot supply row and column offsets when using `dlmread` in this mode, it may be helpful to know how to address the contents of an array column from some fixed row to the end of the array, for example: `a(5:end, 3)`.